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(71) Applicant
T and N Materials
Research Limited
(United Kingdom),
20 St. Mary's Parsonage,
Manchester M3 2NL
(72) Inventors
Alan William Atkinson,
Michael Alan Willis
(74) Agent and/or Address for
Service
D. D. E. Newman, R. F.
Hadfield, J. A. Crux,
20 St. Mary's Parsonage,
Manchester M3 2NL

(54) Making a gasket

(57) A gasket comprising an apertured metal support and a layer of sealant material bonded to it is made by electrophoretically depositing the sealant onto the support. The method is applicable to the manufacture of gaskets with a sealant layer comprising exfoliated vermiculite and an organic polymer.

The support (e.g. stainless steel) may be electroplated with zinc or copper to suppress oxygen evolution during the electrophoretic deposition step.

The gasket may be an exhaust manifold gasket of an automobile engine or an envelope gasket 11 to be bolted between flanges in a high pressure gas or liquid line. To deposit sealant on the latter it is supported on a spider 15 secured to a rotatable shaft 16 and suspended between cathodes 14 in a cell 12.

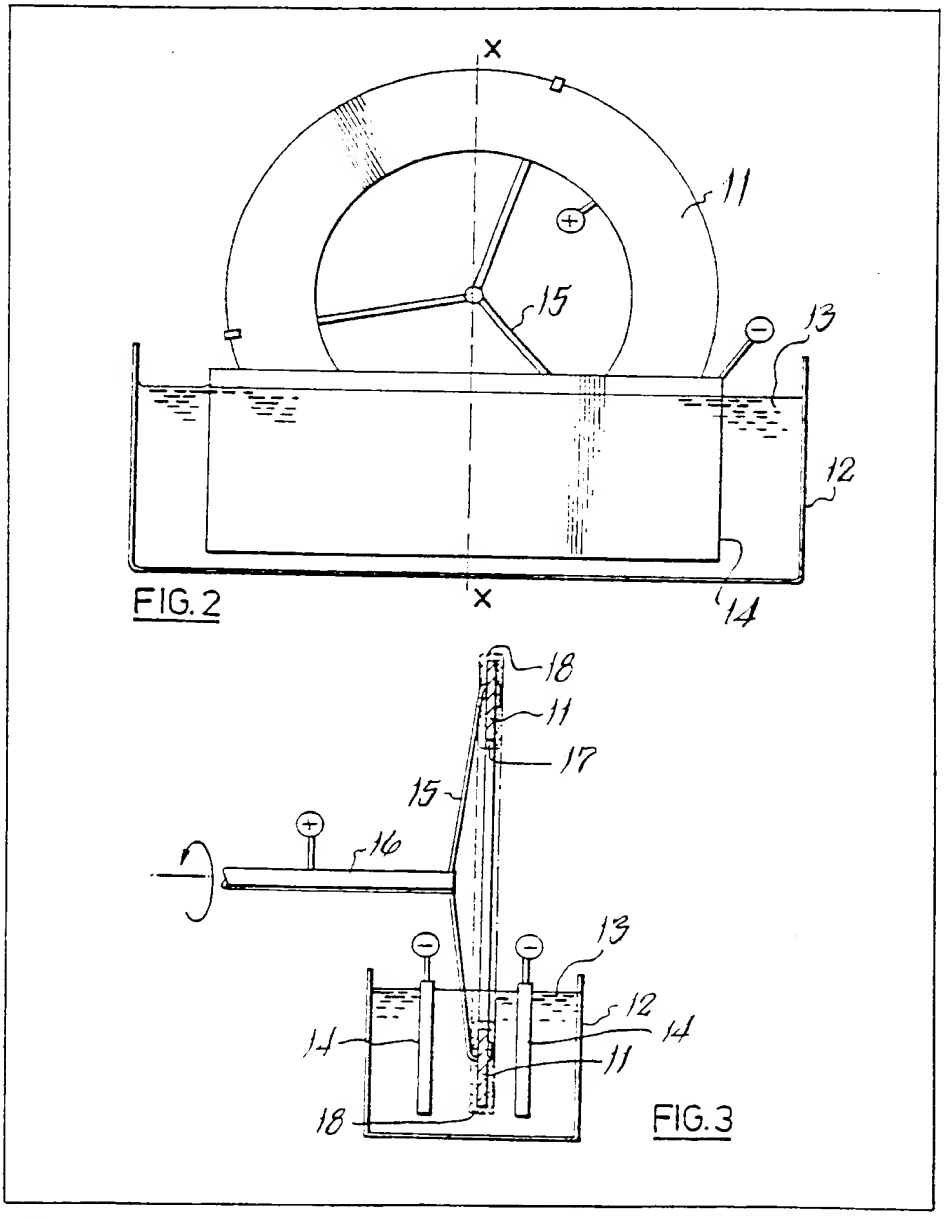

FIG. 2

FIG. 3

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The drawings originally filed were informal and the print here reproduced is taken from a later filed formal copy.

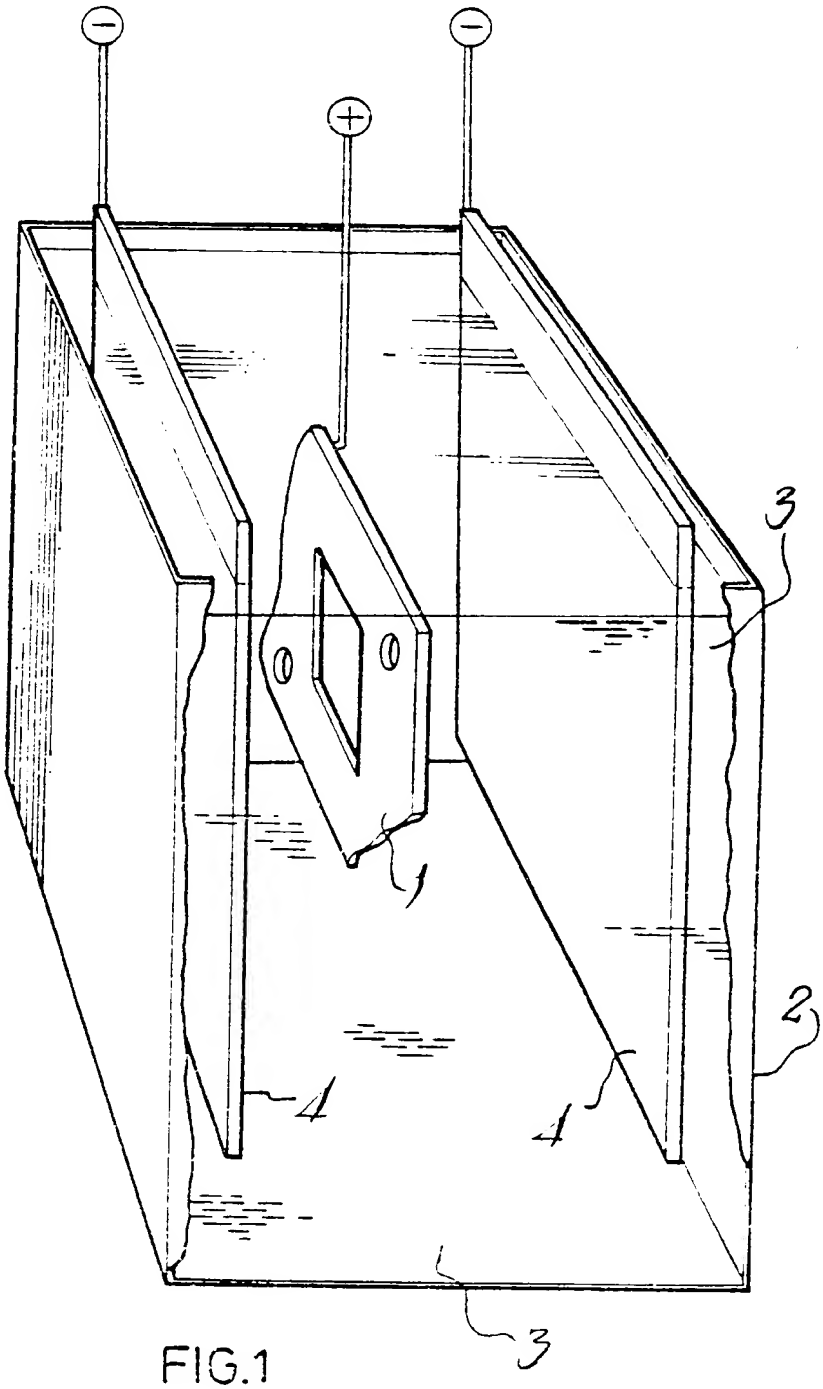

FIG.1

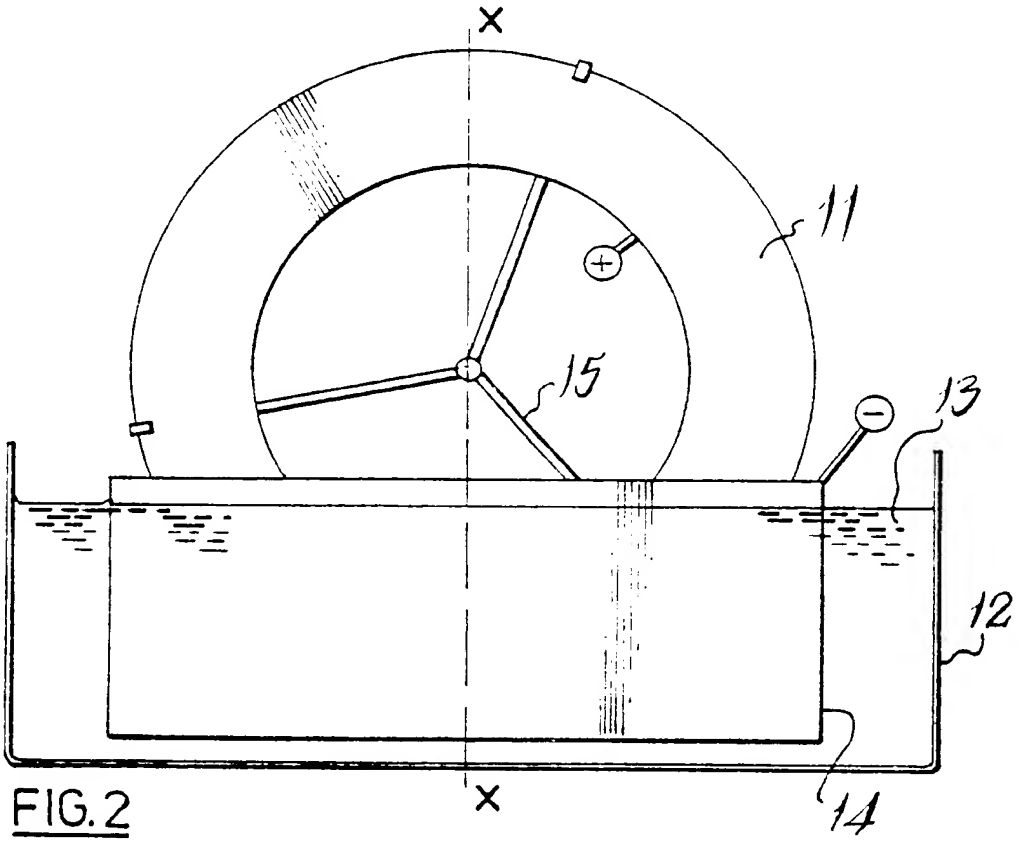

FIG. 2

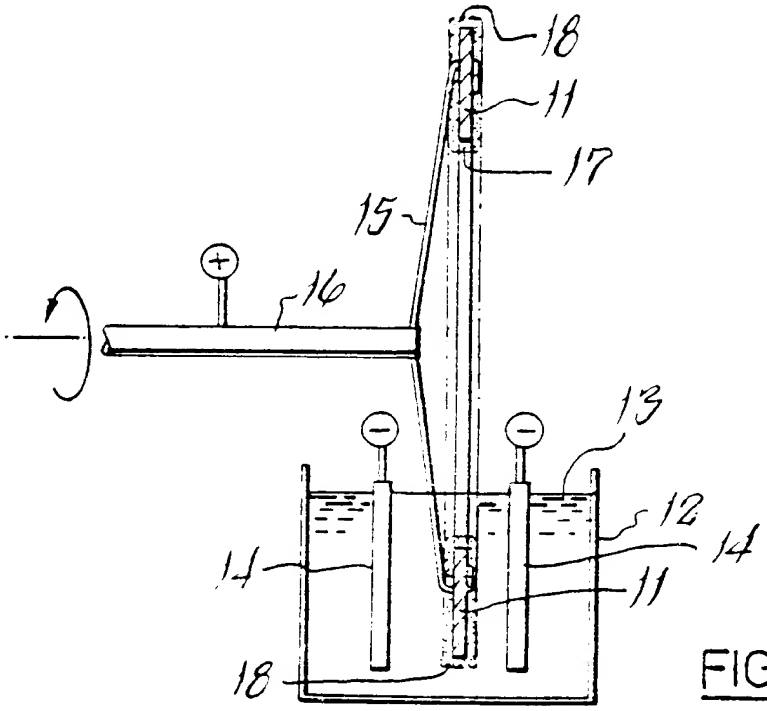

FIG. 3

SPECIFICATION

Method of making a gasket

This invention relates to a method of making a gasket, more particularly that type of gasket which comprises an apertured metal support and a layer of sealant material bonded to it.

A common method of making such a gasket makes use of the sealant material in the form of a water-laid sheet or paper. The paper is cut or punched to form the required aperture(s), assembled in register with the support, and bonded to the support by adhesive so that the apertures in paper and support continue in register. In this method the sealant material cut away, which may amount to 50% of the total, is lost as scrap.

According to the present invention, the sealant layer is formed on the apertured metal support by electrophoretic deposition.

The method of the invention not only avoids waste of sealant material, but also results in a more effective sealing capacity in the gasket that is produced, for sealant material is deposited on the walls of the metal support apertures as well as on the faces of the support.

The method of the invention is particularly applicable to the manufacture of gaskets with a sealant layer having a basis of exfoliated vermiculite or similar expanded layer silicate such as expanded hydrobiotite.

Usually electrophoresis will be carried out in a liquid phase that is aqueous, at a voltage gradient in the range 0.05—3 volts/mm. A preferred range is 0.25—2.5 volts/mm.

Electrophoresis in aqueous suspensions is often accompanied by electrolysis, and this can give rise to gas bubbles, in particular of oxygen, at the electrode (anode) constituted by the metal support. This is specially noticeable when the support is of stainless steel. To avoid this, and the possibility of forming a deposit that is flawed owing to the presence of trapped gas, it is desirable to coat the support with a metal which suppresses oxygen evolution. Zinc, copper, aluminium and very pure iron are suitable for this purpose.

A preferred thickness for the electrophoretically deposited sealant layer is in the range 0.1—0.5 mm, and this can be formed in 10 minutes or less.

After formation of the sealant layer the article thus formed is removed from the aqueous suspension employed for electrophoresis, rinsed with water, and dried, suitably at 50°—100°C.

If a large gasket is to be made it may not be convenient to employ an electrophoresis cell large enough to receive that volume of electrophoresis medium which is necessary for complete immersion of the metal support on which the sealant layer is to be deposited. In that case the support can be mounted so that only its lowest part is immersed in the medium, but mounted for slow rotation so that each part of it can be successively brought into contact with the medium to receive a deposit of sealant material. Several revolutions will be made so as to build up evenly the desired thickness of sealant layer.

If exfoliated vermiculite is to form the basis of the sealant layer, the electrophoresis medium is preferably an aqueous suspension of vermiculite which has been exfoliated chemically rather than thermally. Suitable suspensions may be prepared by the methods described in British Patent Specifications 1016385, 1119305, 1593382 and 1593383.

The medium may also contain additional ingredients intended to form part of the sealant layer, for example; pigments; dispersed organic polymers (conveniently added as a latex) to improve adhesion of the sealant layer to the metal support and to increase the strength, toughness, resilience and water-resistance of the layer. The medium may also contain other water-proofing agents such as glyoxal.

The invention is further illustrated by the Examples herein and with reference to the accompanying drawings, in which;

Fig. 1 is a diagram showing an electrophoresis cell whose anode is the metal support which is to receive a layer of sealant material;

Fig. 2 is a side elevation of a similar cell, set up to form a layer of sealant material on an annular metal support which is too large to be wholly immersed in the cell; and

Fig. 3 is a section on line XX of Fig. 2.

EXAMPLE 1

This Example illustrates the manufacture of an exhaust manifold gasket for an automobile engine.

a. An apertured metal support 1 (see Fig. 1) was punched from galvanised mild steel plate (0.325 mm thick) and suspended in a cell 2 containing a slurry 3 of chemically exfoliated vermiculite. The slurry contained 6.5% percent by weight of vermiculite of particle size less than 50 μm, and had been prepared following generally the procedure of Example 1 (A) in British Patent Specification 1593382.

b. The support 1 was made the anode of the cell, and the cathodes of the cell were perforated tinplate sheets 4 suspended on each side of the support 1. The anode-cathode distance was such as to give a gradient of 1 volt/mm.

c. The vermiculite slurry was gently agitated to keep its solids uniformly suspended, and electrophoretic deposition was begun. A thickness of 0.4 mm of vermiculite built up on each side of the support 1 in 4 minutes, and the side walls of the apertures also became coated with vermiculite.

d. The coated support was then removed from the cell, rinsed with water, and dried at 85°C for 4

hours.

Gaskets produced as just described performed well when tested in a Ford overhead camshaft engine run at full load for 50 hours.

EXAMPLE 2

This Example illustrates the manufacture of an envelope gasket to be bolted between flanges in a high pressure gas or liquid line.

a. A stainless steel ring 11 (see Fig. 2) was punched from strip 0.8 mm thick having internal and external diameters of 76 and 110 mm respectively.

b. A thin plating (0.0125 mm) of zinc was applied to the ring by conventional electrolysis.

c. The zinc-plated ring was mounted on electrically conductive spider 15 (see Fig. 3) secured to rotatable shaft 16, and suspended between identical cathodes 14 of phosphor-bronze woven wire in a slurry 13 of chemically exfoliated vermiculite in cell 12. With the shaft 16 rotated at 1 rpm, electrophoretic deposition was carried out at a gradient of 1.0 volt/mm until a vermiculite deposit 16 of thickness 0.15 mm had been produced on both sides of the ring. The deposit extended at 17 and 18 to envelop the interior and exterior side walls of the ring.

d. After rinsing in water, the gasket was dried at 85°C for 2 hours.

Gaskets produced as described above were bolted between flanges and tested for their ability to retain an applied pressure of nitrogen gas in the following cycle:—

Time (mins)	Temperature (°C)	Applied pressure
0	460	300 psi (= 2.07 MPa)
60	460	300
183	60	150
498	460	300
558	460	300
2678	20	50

Pressure retention was 100% measured at 460°C.

A finished gasket was fitted between 2 inch (50 mm) Class 300 flanges (ANSI Standard) and tested for its ability to seal nitrogen gas under a range of applied clamping loads (ANSI test B16.5, 'Steel Pipe Flanges and Flanged Fittings').

At an applied clamping load of 24 tonnes, the gasket was able to seal a pressure of 22 MPa (i.e. twice the pressure demanded by the Standard).

EXAMPLE 3

This Example illustrates the preparation of an automobile cylinder head gasket having a sealant layer comprising exfoliated vermiculite and polymeric material deposited from an aqueous emulsion (latex).

a. An apertured metal support was punched from galvanised steel sheet and made the anode of an electrophoresis cell as in Example 1. The cathodes were of perforated stainless steel.

b. Electrophoresis was carried out using a liquid phase prepared by mixing 90 parts by weight of a slurry (3.5% solids content) of chemically exfoliated vermiculite with 10 parts by weight of a commercially available acrylic rubber latex (45.5% solids content), being an anionic emulsion of a self-linking acrylic polymer curable at 120°C; pH 4; particle size 0.2 μm. Voltage gradient was 1 volt/mm.

c. After 4 minutes, a dense, firm electrophoretic deposit had formed, of composition (dry weight) 55% vermiculite and 45% acrylic latex solids. The article thus formed was removed from the electrophoresis cell, rinsed in water, dried at 85°C for 2 hours, and finally heated at 120°C to cure the acrylic polymer. The dry electrophoretically deposited layer (0.2 mm thick on each side of the article, and enveloping the walls of the apertures) was tougher than an electrophoretically deposited layer of pure vermiculite, and had much better resistance to water; thus, it withstood 2 hours in boiling water. In ASTM Water Fuel and Oil Resistance Test (No. F104 section 7) it passed with the following results:—

Medium	% Weight Gain
Oil	8.2
Fuel B	20.2
Water	31.3

Pass/fail limit is 50% weight gain.

CLAIMS

1. Method of making a gasket comprising an apertured metal support and a layer of sealant material bonded to it, in which the sealant layer is formed on the support by electrophoretic deposition.

2. Method according to claim 1, in which the sealant layer has a basis of exfoliated vermiculite and is deposited from an aqueous slurry thereof.

3. Method according to claim 2, in which the sealant layer also includes an organic polymer, which is co-deposited with the vermiculite from an aqueous vermiculite slurry which contains said polymer in dispersed form.

4. Method according to claim 1, 2 or 3, in which the sealant layer is electrophoretically deposited onto a metal which suppresses oxygen evolution.

5. Method according to claim 4, in which the metal is zinc.

6. Method according to claim 4, in which the metal is copper.

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